The *Tripteroides caledonica* Complex of Mosquitoes in Melanesia (Diptera: Culicidae)

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INTRODUCTION

EDWARDS (1922: 100–101) described *Tripteroides caledonica* (as *Rachionotomyia*) from one male and one female bred from a *Nepenthes* pitcher, Houailou, New Caledonia, July 31 and Aug. 1, 1914 (Paul D. Montague). No larvae, pupae or exuviae were apparently preserved. Until the present study was practically completed no additional specimens had been collected from *Nepenthes* but *T. "caledonica"* had been reported by several workers as breeding in tree holes, coconut husks and shells, artificial containers, and leaf axils of various plants in New Caledonia, the Loyalty Islands and the New Hebrides. Buxton and Hopkins (1927: 76) reported that some of their specimens collected in the New Hebrides were marked by Edwards as a variety of *caledonica*. Perry (1946: 13) noted a great deal of variation in the larval stage of this "species" in the New Hebrides, and Knight (1953, *in lit.*) suspected that specimens bred from banana axils from these islands represented a distinct form. Recently, Dr. E. N. Marks noted marked differences in the larval material, presumably of this species, collected by Miss E. Cheesman in flower bracts of palms in New Caledonia, and in a tree hole in *Araucaria cookii* in the Loyalty Islands, and expressed the opinion that the two forms were subspecifically distinct (Mattingly, 1952, *in lit.*).

Since all the species of *Tripteroides* known to breed in *Nepenthes* are restricted to this specialized habitat (Baisas and Ubaldo-Pagayon, 1952: 17–22), it appeared that there might be a complex of sibling species misidentified under the name of *T. caledonica*. To clarify this situation I undertook to study the specimens from the British Museum (Nat. Hist.) through the courtesy of Dr. P. F. Mattingly, as well as all material identified as *caledonica* in the collections of the U. S. National Museum through the courtesy of Dr. E. A. Chapin and Dr. Alan Stone.

After this study was completed, I received additional material collected in the New Hebrides and the Belep group by Dr. and Mrs. Marshall Laird under the auspices of the Royal New Zealand Air Force and the New Zealand Department of Scientific and Industrial Research. Finally I was fortunate in enlisting the co-operation of Mr. L. J. Dumbleton of the South Pacific Commission, Noumea, New Caledonia. Mr. Dumbleton obtained typical *T. caledonica* material from *Nepenthes* pitchers. It is gratifying to note that the conclusions reached before this material became available did not need to be modified to any extent.

I wish to express my thanks to the above-mentioned individuals and agencies for the opportunity to study this most interesting complex of mosquitoes. I am also indebted to William A. McDonald, Lee R. Brown, and Roy Pence, of the Department of Entomology, University of California, Los Angeles, for assistance in this study.

The material examined leaves much to be desired, since not a single progeny rearing is represented and only a few individual pupal

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rearings of one species are available. The adults of this complex are so similar that they would require a time-consuming study which could not be made at this time. Nevertheless, certain trends can be seen and with more adequate and more numerous material diagnostic characters may become more obvious. The pupal material is also scanty and contributed very little to the understanding of the complex. Therefore this study is based almost entirely on larval characters, and consequently the new species described herein have larvae for holotypes. Much additional larval material as well as precise ecological information about breeding places is needed to understand this complex thoroughly. Since all this as well as crossbreeding experiments cannot be obtained in the foreseeable future, the results of this limited morphological study are presented at this time in the hope that they may stimulate such studies in this group.

All the forms discussed are closely related and in general quite similar, therefore only one of them, *T. melanesiensis*, is figured in detail and the others compared with it. The descriptive terminology used is the same as in Belkin (1953a) with later corrections in larval and pupal chaetotaxy (Belkin, 1953b). This terminology does not include the ventral (and ventrolateral) and the dorsal (and dorsolateral) hairs of the siphon which are found in sabethines, as well as in *Culex* and some *Aedes* and *Culiseta*. I propose to call these groups of hairs 1a-S and 2a-S respectively without a specific nomenclature for each hair, since the number of hairs in each group varies not only from species to species but in individuals of the same species. It appears to me that the simplest explanation for the origin of these hairs is through duplications of hairs 1-S and 2-S.

GENERAL CONSIDERATIONS

Composition of the Complex

The *caledonica* complex has been assigned to the Australasian subgenus *Mimeteomyia* Theobald, 1910 (type species: *M. apicotriangulata* Theobald, 1910 (=*T.* (*M.*) *atripes* Skuse), Kurunda, Queensland; monobasic). Edwards (1932: 76) and Lee (1946: 225) have designated *caledonica* as the typical representative of one of the groups within the subgenus. I am changing their terminology from group to section to distinguish it from species group. The *caledonica* section is separated from the other sections in the adult stage by the proboscis being very slender and distinctly longer than the abdomen and by the male palpi being about 0.7 to 0.8 as long as the proboscis. All the known larvae of this section have no comb plate and also lack the development of mesothoracic hair 7 into a spine. Four of the species assigned by Lee (1946: 225) to this section are not closely related to *caledonica* complex and all of them occur in New Guinea or North Queensland. The remaining three species formerly recognized, *caledonica*, *rotumana* and *tasmaniensis* (Strickland, 1911) appear to form a natural group. I have not seen any material of the latter but the descriptions of Edwards (1929: 337–338) and Lee (1946: 267–268) are sufficiently detailed to recognize it. The adults of this group all have the pleural scaling confined to longitudinal bands and the disc of the scutum with small narrow scales and with several dorsocentral bristles. The larvae appear to be all of the same general type. *T. rotumana* is extremely close to *caledonica* as understood by Edwards and differs from it in the adult stage only in having basally instead of apically placed light tergal markings on the abdomen and in lacking lower sternopleural bristles. For this reason I consider *rotumana* a member of the *caledonica* complex. On the other hand, *T. tasmaniensis*, reported breeding in rock pools and tree holes in Tasmania and the eastern portion of New South Wales, is strongly differentiated from the other forms in the adult stage by its ornamented legs and by having the pleura bare in the middle as opposed to entirely dark legs and pleura scaled in the middle.

It is, therefore, excluded from the *caledonica* complex.

In the material of the *caledonica* complex available to me there appear to be several ecospecies, ecotypes, ecophenotypes and geographical races, clearly marked in the larval stage but generally without striking differences in the male genitalia, adult coloration or in the pupal stage. The larval characters of three of these forms are so constant and uniform that I consider these three as distinct species: *caledonica*, from *Nepenthes* pitchers in New Caledonia; *folicola*, from leaf axils of various plants in Espiritu Santo, New Hebrides; and *rotumana*, from Rotuma Is., north of Fiji. Aside from these stabilized segregates, the *caledonica* complex consists of a multitude of larval forms utilizing a variety of breeding habitats from "palm-bracts" and tree holes to bamboo, coconut shells and artificial containers in the New Hebrides, Loyalties and New Caledonia and adjacent islands. All of these I consider, at the present time, members of a highly plastic, polymorphic, actively evolving species, *T. melanesiensis*. As discussed under this species, there appear to be included in this assemblage at least two major geographical races and a bewildering array of ecological and minor geographical races in various stages of evolution towards distinct species, a condition fully attained by *caledonica*, *folicola* and *rotumana*. In view of the absence of controlled progeny rearings and crossbreeding experiments, it may be argued that a simpler interpretation of all these different larval types would be that the entire *caledonica* complex is one highly plastic species with a multitude of ecophenotypes. While it is true that some mosquito species show considerable modifications correlated with different larval habitats, as for example the length of the siphon and of the anal gills, particularly in brackish and fresh water, none of these modifications are as distinct, constant or numerous as in *caledonica*, *folicola* or *rotumana*. Furthermore sympatric, as well as allopatric, ecological speciation seems to be the rule in mosquitoes utilizing small collections of water in living plants or dead plant material as breeding sites, as for example in the *Aedes kochi* complex in the Solomons and in the genus *Wyeomyia* in the Neotropical region. A large number of such ecospecies are species-specific in regard to the host plants while others may have a wide range of hosts. The main difference between speciation in these taxa and that found in the *caledonica* complex is that in the former the diagnostic larval characters are often accompanied, and sometimes exceeded, by genitalic characters in the male and color characters in both sexes in the adult stage. In the genus *Tripteroides* several groups of otherwise quite distinct species exhibit no noticeable differences in male genitalia as in the case of the *caledonica* complex. Similarly several other groups in this genus are also characterized by a uniform drab coloration in the adult stage.

Zoogeography

The zoogeographic relations of the *caledonica* complex are of considerable interest. The nearest unmistakable relative is *T. tasmaniensis* from Tasmania and the eastern part of New South Wales. Other than this there is no close similarity between this complex and any of the other species of *Tripteroides* in the surrounding areas. The one species found in New Zealand, *T. argyropa* (Walker, 1848), is so distinct that it has been placed in the monotypic subgenus, *Maorigoeldia*, which is probably worthy of full generic rank. To the east, only the Fijian *T. purpurata* (Edwards, 1921) is known and it is undoubtedly a member of the subgenus *Tripteroides*, showing affinities with *T. distigma* (Edwards, 1925) of the Solomons. In the Solomons nothing even remotely resembling the *caledonica* complex has been recognized. The next closest relatives of the complex are found in the second group of the *caledonica* section, represented in Australia by *collessi* Lee, 1946 from Upper Baron, North Queensland and in the Solomons by the aberrant *coheni* Belkin, 1950. The

center of this group is undoubtedly in New Guinea where *argenteiventris* (Theobald, 1905), *atra* (Taylor, 1914), and *microlepis* (Edwards, 1927) are found. Still more remotely allied is the *atripes* section of *Mimeteomyia*, which is represented in Australia (N. S. Wales, Queensland and Northern Territory) by *atripes* (Skuse, 1899) and *punctolateralis* (Theobald, 1903), and is apparently absent from New Guinea or at least not represented by the *atripes* complex. This particular complex is of interest here for it has a member, *T. solomonis* (Edwards, 1924) in the Solomon Islands. Both the *atripes* complex and the *caledonica* complex utilize artificial containers to some extent for breeding and it is possible that they arrived or spread in Melanesia in recent times through accidental human transport. On the other hand their mutual exclusion in Melanesia is against such a simple interpretation and favors an earlier origin from continental Australia, at least for the *caledonica* complex. This does not imply a continuous land connection, for it is quite evident that mosquitoes are capable of crossing considerable expanses of water through natural means of dispersal. The present distribution of mosquitoes of the genus *Tripteroides* in southern and eastern Melanesia is peculiar and analogous to the distribution of the human racial stocks in this area, although it does not follow the same plan. The *caledonica* complex has apparently come from Australia and has more recently extended to the northeast to Rotuma Island. *T. purpurata*, the only other eastern outpost of the genus, has undoubtedly come by way of the Solomon Islands to its present position to the southeast, in Fiji. This has resulted in a complete crossing of the paths of dispersal of these two different lines. Unfortunately we have no records of mosquitoes of this genus from the Santa Cruz group which may have served as a stepping stone for both dispersals. It is not beyond the realm of possibility that the extensions to Rotuma and Fiji have been made in recent times through human agency by transport in canoes. Considering the numerous movements of the Melanesians and Polynesians in this area, it is surprising that more species of mosquitoes capable of being transported in such a way have not spread more widely.

Within the *caledonica* complex itself the geographic and ecological relations are also of interest. In New Caledonia, adjacent islands, and the Loyalties two species of the complex are represented, *caledonica* in *Nepenthes* pitchers and *melanesiensis* in tree holes, bamboo, artificial containers and "palm-bracts." All the larval ecological types of *melanesiensis* in this area are remarkably similar when compared with the parallel forms in the New Hebrides, but one of them, the "palm-bract" race, may prove to be a distinct species. In the New Hebrides two distinct species are also recognized, *folicola* restricted to leaf axils of living plants on Espiritu Santo, and *melanesiensis*, breeding in a wide variety of habitats throughout the New Hebrides. The ecological and geographic forms of *melanesiensis* in this area are much more numerous and exhibit much greater divergence. A single island, as Espiritu Santo, may have as many as four distinct larval types, each restricted to a distinct habitat. Furthermore parallel ecological types on different islands often exhibit striking differences which become more extreme toward the northern portion of the range. Finally, some 600 miles to the northeast of the New Hebrides, on the small island of Rotuma, we find *rotumana*, a species strongly differentiated from the rest of the complex in the adult stage, but very similar to *melanesiensis* in the larva.

To summarize: On the basis of present knowledge of the *caledonica* complex, it appears that it was derived from continental Australia and first reached New Caledonia, probably by means of intermediate islands no longer in existence in the region of the Chesterfield group (Routhier, 1953: 244–246). In New Caledonia, the uniform southern race of *melanesiensis* represents the original stock from which were derived at an early date the aber-

rant *caledonica* and the "palm-bract" race of *melanesiensis* and probably at a later date the populations on the adjacent island groups, Loyalties and Belep. The invasion of the New Hebrides is much more recent but has given rise to a new and now active center of speciation. Probably the atypical northern races of *melanesiensis* represent the original stocks in this area. From these have been derived the typical race of *melanesiensis* in the northern New Hebrides, *folicola* of Espiritu Santo and *rotumana* of Rotuma Island. The dispersal within the New Hebrides has probably been accomplished largely through natural means although, within recent times, it has undoubtedly been influenced by movements of human populations. On the other hand, it seems improbable that Rotuma Island has been reached through natural means, for the distance involved appears too great and there is no geological evidence of former intermediate island arcs; furthermore it is known that Rotumans visited the New Hebrides several times in the past.

Ecology

Other than brief notes on habitats, considered under each species, little information is available on the larval ecology of the complex. Miss E. Cheesman (1952, *in lit.*) observed larger larvae of the "palm-bract" race of *melanesiensis* feeding on smaller ones as well as on dead flies but she never observed this behavior in Araucaria breeders.

Adults of *melanesiensis* have been reported resting near breeding places and on tree trunks and not attacking man on Espiritu Santo in the New Hebrides (Knight, *in lit.;* Perry, 1946: 14). Miss Cheesman (*loc. cit.*) reports being bitten on two occasions by Araucaria breeders but never by "palm-bract" breeders. No information is available for the other species.

Larval Characters

The *caledonica* complex, as understood here, is difficult to characterize in the fourth instar larva but the following features are shared by the majority of the forms:

Head: About as wide as long; maxillary suture well developed; dorsal hairs single or with a few branches; hairs 0,3-C minute, placed on lower surface; 4–7-C placed far forward; 8-C only slightly cephalad of 9-C; 11–13-C far forward and close together; 15-C near occipital border, multiple. Antenna slender, about five or six times as long as wide, concave laterally; 1-A arising at about 0.6 or distad.

Thorax: 0,1,3,4,7,8,13,14-P usually stellate (except in *caledonica*); 2,5,6,10,12-P single; 9-P usually multiple; 11-P single or branched; 1–3-P and 5,6-P on common tubercles; 1,8,13,14-M usually stellate (except in *caledonica*); 2–7,10,12-M single; 9-M multiple; 11-M single or branched; 6,7-M on common tubercle; 7-M long, thin; 1,4,5,8,13-T usually stellate (except in *caledonica*); 2,3,6,10,12-T single; 7-T single to triple, spine-like or hair-like; 9-T multiple; 11-T single or branched; 7,8-T on common tubercle.

Abdomen: 0,14-II–VI, 1,2,5,9,10,13-I–VII usually stellate (except in *caledonica*); 11-II–VII, 3,4,12-I–VII always single; 0,8,11,14-I absent; comb plate not developed; 1-VIII usually stellate (except in *caledonica*); 1-S well differentiated from 1a-S.

All the features of the larval morphology, except perhaps the head capsule, show a great deal of variation, individual, ecological and racial, in *melanesiensis*, but in the other three species they have become fixed within rather narrow limits. Particularly variable in *melanesiensis* are the length of the siphon, number of pecten teeth and comb scales, length of anal gills, and development of stellate tufts, metathoracic spine and accessory siphonal hairs.

Pupal Characters

It is impossible to generalize on the pupal characters of the complex since very little material is available. All the male pupae ex-

hibit a sexual character not formerly recognized in the presence of a pair of elongate transverse submedian dark spots on abdominal tergites 2–4. The length and shape of the trumpet appear to be reliable taxonomic characters as well as the development of abdominal hairs 1, 2 and 5 on some segments. On the other hand the length and shape of the paddle, but not its marginal fringe, are extremely variable in *melanesiensis* and are undoubtedly correlated with the development of the siphon, an unreliable character in the larva.

Adult Characters

A character not formerly noted for this complex, or for any *Tripteroides*, to my knowledge, is the development of a few outstanding long, thin, somewhat flattened hairlike scales or scalelike bristles on the midline of the mesonotum just in front of the prescutellar space. These may represent highly modified posterior acrostichal bristles. Apparently their presence is dependent upon the vigor of the individual since they have been noted only on larger specimens of all the species examined.

Except for *rotumana*, no striking diagnostic characters have been found in the complex. The male genitalia show considerable variation in the clasper and in the number of bristles on the basal lobe of the sidepiece and lobe of the ninth tergite. None of these variations appear to be correlated with larval characters. *T. caledonica* appears to be unique in the development of a few broad dark scales in the supraalar area. A great deal of variation was noted in the thoracic chaetotaxy, particularly in the development of dorsocentrals, but this was not studied in detail. The distribution and amount of light scaling on the head, thorax and abdomen show differences that appear to be correlated with geographical distribution as noted under *melanesiensis*. Before these characters can be used for diagnosis much more and better material must be accumulated.

Keys to Species

1. ADULTS (MALES AND FEMALES)

1. Abdominal tergites with basal lateral light spots; lower sternopleural bristles absent ..... *T. rotumana* (Edwards)

   Abdominal tergites entirely dark or with apical light bands or apicolateral light spots; lower sternopleural bristles present 2

2. Supraalar area with several broad, apically rounded dark scales ..... *T. caledonica* (Edwards)

   Supraalar area with only narrow, pointed dark scales ..... *T. melanesiensis* n. sp.
   T. folicola n. sp.

2. PUPAE

1. Trumpet narrow, parallel sided; trumpet index 4 or more ... *T. rotumana* (Edwards)

   Trumpet expanded distad; trumpet index 3 or less 2

2. Trumpet width at basal 0.1 about 0.25 of width at middle; paddle margins with several dorsal rows of distinct spicules ..... *T. caledonica* (Edwards)

   Trumpet width at basal 0.1 usually 0.5 or more of width at middle; paddle margins with spicules absent or few and scattered . 3

3. Hairs 5-IV–VI usually double; pinna about 0.30 of trumpet length . . *T. folicola* n. sp.

   Hairs 5-IV–VI usually single; pinna about 0.15 to 0.20 of trumpet length ..... *T. melanesiensis* n. sp.

3. LARVAE

1. Hairs 0-II–VII, 2-I–VII minute, single; dorsum of thorax and abdomen without distinct stellate hairs ..... *T. caledonica* (Edwards)

   Hairs 0-II–VII, 2-I–VII large, stellate; dorsum of thorax and abdomen with distinct stellate hairs 2

2. Hair 14-VII minute or small, single; hair 8-VII small, not stellate..... .....*T. rotumana* (Edwards)

Hair 14-VII large, branched and stellate; hair 8-VII usually large, stellate.....3

3. Accessory ventral siphonal hairs, 1a-S, absent from basal third, usually single and less than 6 in number; stellate hairs of abdomen usually with 30 or more branches .....*T. folicola* n. sp.

Accessory ventral siphonal hairs, 1a-S, present on basal third, usually at least double and 8 or more in number; stellate hairs of abdomen with at most 25 branches..... .....*T. melanesiensis* n. sp.

1. T. (M.) caledonica (Edwards, 1922) Fig. 1

1922. *Rachionotomyia caledonica* Edwards, Bul. Ent. Res. 13: 100–101. *Types:* Male and female, Houailou, New Caledonia, July 31 and Aug. 1, 1914, bred from pitcher of *Nepenthes* (P. D. Montague) [BM NH].

1924. *Rachionotomyia caledonica*. Edwards, Bul. Ent. Res. 14: 361–362.

1927. *Rachionotomyia caledonica*. Buxton and Hopkins, Res. Polyn. and Melan. I-IV: 74 (*partim*).

1932. *Tripteroides* (*M.*) *caledonica*. Edwards, Genera Insectorum 194: 77 (*partim*).

1944. *Tripteroides* (*M.*) *caledonica*. Lee, Atlas Mosq. Larv. Australasian Reg. p. 22 (*partim*).

1944. *Tripteroides caledonica*. Knight, Bohart and Bohart. Keys Mosq. Australasian Reg. pp. 19, 67 (*partim*).

1946. *Tripteroides* (*M.*) *caledonica*. Lee, Linn. Soc. N.S.W., Proc. 70: 265 (*partim*).

Diagnosis

ADULTS.—Abdomen with apical light bands well developed. Supraalar area of mesonotum with several broad, apically rounded or truncate, dark scales. Lower sternopleural bristles present.

PUPA.—Pigmentation practically absent except for dark brown dorsum of cephalothorax, abdominal intersegmental areas, and base of abdomen middorsally; trumpet very dark brown, lighter apically; integumentary abdominal sculpturing distinct only on darker areas. Trumpet index about 2.3; width at basal 0.1 about 0.25 of that at middle; pinna about 0.39. Hairs 5-IV–VI(1); 2-II–VII(1); 1-II(simply branched); 1-IV–VI(1–3b). Paddle index about 1.55; midrib broad; inner and outer margins with several dorsal rows of distinct spicules.

LARVA.—Head capsule dark blackish brown; integument of thorax and abdomen completely unpigmented except for sclerotizations. Head width about 1.05 of length, greatest caudad of eye; hairs 14-C(2b, slender), 15-C(1,2f,b). Thorax and abdomen without conspicuous stellate hairs, corresponding hairs single or with at most 6 or 7 short branches; large single hairs swollen and fringed near base. Thoracic hairs: 1-P(3b, longer than 3-P); 2-P(1, about as long as 1-P); 3-P(3, 4b, apices attenuate); 5-P(1, over 3 times as long as 1-P); 7-T(1, hairlike, not spinelike); 13-T(7b, large and with branches of uneven lengths). Abdominal hairs: 2-I–VII, 0,14-II–VII(1, minute or small); 10-I–VII(2-4b, well developed, most conspicuous ventral hair). Comb scales about 15 to 20, blunt and fringed apically and on one side. Siphon index about 2.5; pecten teeth (1 on left side only; minute; sharply pointed, fringed laterally); hair 1(3b), 1a(usually 9, mostly single), 2a (usually 7, all single, heavy, long). Anal segment: dorsal gill about 1.7 of saddle; ventral gill slightly shorter than saddle; hair 1 (2b), 2(2b), 4(2b, about 3.3 of saddle).

FIG. 1. *Tripteroides* (*M.*) *caledonica* (Edwards, 1922). Fourth instar larva; terminal abdominal segments, left lateral aspect. La Coulee River, New Caledonia, *Nepenthes* pitcher (L. J. Dumbleton).

Description

ADULTS.—Very similar to *melanesiensis*. I have seen six females, four pinned, one preserved in alcohol and the other fully developed *in situ* in the pupal skin, and eight males, three pinned and five *in situ* in pupal skins. Both sexes may be separated from *T. melanesiensis* by the presence of several broad, semi-appressed, apically rounded or truncate, dark scales among the posterior supraalar bristles. The following additional information about the types, obtained by Dr. Mattingly at my request, may be of interest: whitish scales in front of wing root are not broad and flat but a trifle broader than elsewhere (as in *melanesiensis*); dorsocentrals seven on each side in line plus three or four at posterior end and two or more prescutellars (mesonotum disfigured in this region in both specimens); posterior pronotum with white scales in upper part (as in *melanesiensis*); lower sternopleuron with scales and bristles as in *melanesiensis;* propleurals four. *Male.*—Leg 1: femur 1; tibia 0.96; tarsus 0.61, 0.31, 0.21, 0.04, 0.08; leg 2: femur 0.90; tibia 0.99; tarsus 0.75, 0.39, 0.24, 0.06, 0.06; leg 3: femur 0.86; tibia 0.84; tarsus 1.08, 0.63, 0.46, 0.29, 0.11. *Female.*—Leg 1: femur 1; tibia 0.99; tarsus 0.66, 0.36, 0.23, 0.11, 0.08; leg 2: femur 0.93; tibia 1.03; tarsus 0.78, 0.43, 0.25, 0.11, 0.07; leg 3: femur 0.90; tibia 0.92; tarsus 1.08, 0.64, 0.47, 0.29, 0.10.

PUPA.—Abdomen: 3.60 mm. Trumpet: 0.45 mm. Paddle: 0.50 mm. *Cephalothorax:* Very lightly pigmented except middorsally and on metanotum. Trumpet very dark brown, lighter apically; length about 2.3 median width; basal 0.11 parallel sided, width about 0.25 of median width; distally suddenly expanded; smooth convex on posterior margin, with a medium bulge on anterior margin; inner wall distinctly separated to apex on anterior margin; tracheoid on mesal surface of basal stalk only; reticulate distinct, without conspicuous spicules; pinna about 0.39. Hairs heavily to moderately pigmented. Hairs: 1(2b from base, very long), 2(2b from near base), 3(1, equal to 2, about one-fourth length of 1), 4(2b, long), 5(1, long), 6(1, short), 7(4b, moderate), 8(1, about half as long as 1), 9(1,2b, about one-third as long as 1), 10(2b, short), 11(1, medium), 12(1, long).

Abdomen: Very lightly pigmented except middorsally proximad, intersegmental areas very dark at base; integumentary sculpturing distinct on darker segmental areas; tergites 2–4 each with a pair of elongate transverse submedian dark spots (male character). All hairs moderately to well pigmented. Segment 1: hair 1 (about 30 primary branches, arising from elongate stem and enlarged base, with sec-

ondary branches and thin fringes), 2(1), 3(1), 4(1, thin), 5(3b), 6(1), 7(1), 10(1). Segment 2: 0(1, minute), 1(3, 4b), 2(1), 3(1), 4(2,3b), 5(1), 6(1, reaching apex of next tergite), 7(1, ventral), 10(2b, ventral), 12(1, lightly pigmented), 14(not seen). Segment 3: hair 0(1, minute), 1(1–3b), 2(1), 3(1), 4(1,2b), 5(1,2b), 6(1,2b), 7(1), 8(1), 10(1), 11(1), 12(1), 14(1, minute). Segment 4: hair 0(1, minute), 1(2, 3b), 2(1), 3(2,3b), 4(2b), 5(1), 6(2,3b), 7(1), 8(3b), 10(2b,f), 11(1,2b), 12(1), 14(1, minute). Segment 5: hair 0(1, minute), 1(1,2b), 2(1), 3(1), 4(2,3b), 5(1), 6(1,2b), 7(1), 8(1, 3b), 10(1), 11(1), 12(1), 14(1, minute). Segment 6: hair 0(1, minute), 1(1, sometimes with long thin fringes), 2(1), 3(1), 4(1,2b), 5(1), 6(1), 7(1), 8(2,3b), 10(1), 11(1), 12(1), 14(1, minute). Segment 7: hair 0(1, minute), 1(1), 2(1), 3(1), 4(1), 5(1), 6(2b), 7(6–8b), 8(1,2f), 10(1), 11(1), 12(1), 14(1, minute). Segment 8: 0(1), 5(1, reaching about halfway down paddle), 7(12,13b), 14(1, minute). Segment 9: dorsal lobe extending to 0.38 of paddle, hair 1 apparently not developed. Paddle width about 0.65 length; very lightly pigmented; midrib broad and strongly sclerotized at base, evanescent apically; margin with several dorsal rows of distinct long spicules from base externally around apex to basal third internally; hairs absent. Male genital lobe extending to about 0.75 of paddle.

LARVA.—Head: 0.84 mm. Siphon: 0.60 mm. Anal saddle: 0.25 mm.

Head: Width about 1.05 of length, widest part caudad of eye; pigmentation a dark blackish brown, rather mottled; sculpturing indistinct; mental plate black, large, with about 22 teeth, median three strongly projecting from remainder; gula short, very broad caudally, maxillary sutures strongly diverging. Hairs of head capsule same color as integument or darker. Chaetotaxy as in *melanesiensis* except as noted; hair 5(1, not as strong, more cephalic and mesal, almost in line with hair 1), 6(1, heaviest hair on dorsum, more mesal), 7(2b, shorter), 8(2b), 9(3b), 11(1, strong black spike), 12(2b, shorter), 13(1, strong, long, closer to 12 than 11), 14(2b, slender), 15(1, 2f, b). Antenna about 0.3 of head, apex produced on mesal angle; width at middle about 0.16 of length; shaft hair at about 0.72; pigmentation as on head capsule, sculpturing more distinct. Antennal hairs lighter than on head capsule; all hairs single; 6-A short, slender, reaching to 0.7 of transparent part of 5-A.

Thorax: Integument completely unpigmented: hairs very darkly pigmented a blackish brown; tubercles lighter, distinct only for 1–3-P, 5,6-P, 9–12-P, 2-M, 5-M, 6,7-M, 9–12-M, 7-T, 9–12-T, 13-T; stellate hairs not developed, or reduced, corresponding hairs simple or with at most 6,7 short branches (except 13-T); large simple hairs swollen a short distance from base and with distinct fringes on enlargement; hair arrangement generally as in *melanesiensis* except as noted. Prothorax: 0(4,5b, stellate but short and inconspicuous), 1(3b, apices sharply pointed, longer than 3-P, arising in deep alveolus on edge of tubercle of 2-P), 2(1, about as long as 1-P, apex attenuate), 3(3,4b, apices attenuate), 4(2,3b, apices sharply pointed or fringed, about as long as 3-P), 5(1, long, over 0.5 mm., enlargement near base, on common tubercle with 6), 6(1, long, about 0.66 of 5), 7(3b, a little longer than 1; close to 6), 8(3b, about equal to 3, more ventral than in *melanesiensis*), 9(2,3b), 10(1), 11(2b, short), 12(1), 13(3,4b), 14(5,6b). Mesothorax: 1(1–3b, minute to short), 2(1, long), 3(1, more cephalic than in *melanesiensis*), 4(1, medium), 5(1, longest dorsal hair, with enlargement near base), 6(1), 7(1, with enlargement near base), 8(2,3b), 9(4b), 10(1), 11(1), 12(1), 13(3,4b), 14(1–3,4b, minute to small). Metathorax: 1–4(1), 5(1–3b, small), 6(1), 7(1, hairlike not spinelike, sharply attenuate, short, spiculate), 8(2,3b), 9(4,5b), 10(1), 11(1,2b), 12(1, medium), 13(7b, large, with branches of uneven lengths).

Abdomen: Pigmentation as on thorax; tubercles distinct for 6,7-I,II and 6-III–VI; stellate hairs undeveloped or inconspicuous, cor-

responding hairs simple or with at most 6 short branches; large simple hairs as on thorax; hairs 0, 2 and 14 minute or small, always simple; pattern of chaetotaxy generally as in *melanesiensis*; hair 10-I–VI(2–4b, well developed and most conspicuous hair on venter), 9-I–VI(1–4b, also well developed), 5-I–VI(2–4b, moderately developed, most conspicuous dorsal hair), 13-I–VI(1–4b, extremely variable in development, often very small), 1-I–VI(1–5b, usually small, inconspicuous, sometimes minute), 6-I–VI(usually single, sometimes double on I); other hairs on I–VI simple. Terminal abdominal segments as in Figure 1.

Discussion

T. caledonica has been reported only from New Caledonia and breeds exclusively in *Nepenthes* pitchers. The larvae are unlike those of any other member of the complex in that hairs 0, 2 and 14 are inconspicuous, single, minute or small hairs instead of large, stellate tufts on all abdominal segments. There is a considerable variation in the development of other hairs which are stellate in related species, but, in the material examined, there is no overlap with these species. As noted in the description, there are a number of unique larval characters which, together with the features mentioned above, make this larva superficially so strikingly different that without correlation with the adults it would not appear to belong to the complex. At the same time, the general degree of development of the chaetotaxy of the fourth instar larva of *caledonica* is reminiscent of the condition found in the younger instars of the more generalized members of the complex. This "pseudoneotenic" condition, found in many other *Tripteroides* breeding in *Nepenthes*, is apparently not entirely genetic and may be associated, to some extent at least, with the unfavorable breeding environment as shown by the considerable individual variation.

While the pupae and adults are generally similar to *melanesiensis* and *folicola*, they also appear to possess distinctive characters. Additional material of all stages is much desired to establish the normal range of variation in this species.

To date *caledonica* is the only species of its section reported breeding in *Nepenthes* pitchers but it seems that others must exist in areas in New Guinea and islands to the east, as well as in northeastern Australia, where *Nepenthes* occurs and where this section is represented by other species. Utilization of this unusual larval habitat is characteristic of the entire genus and has resulted in extensive speciation in New Guinea and the Philippines.

Distribution

NEW CALEDONIA, *Houailou:* 1M, 1F, July 31 and August 1, 1914, bred from pitcher of *Nepenthes* (P. D. Montague) [BMNH]. *La Coulee River:* 8M, 6F, 9P, 12L, February, 1954, in *Nepenthes* pitcher (L. J. Dumbleton) [US NM, BMNH, JNB].

2. ***T.*** **(*M.*) *folicola*** Belkin, new species
Fig. 2

1944. *Tripteroides caledonica*. Knight, Bohart and Bohart. Keys Mosq. Australasian Reg. pp. 19, 67 (*partim*).

1946. *Tripteroides* (*M.*) *caledonica*. Perry, Pan-Pacific Ent. 22: 13–14 (*partim*).

Diagnosis

ADULTS.—Abdomen with apical light abdominal bands poorly developed or absent. Supraalar area without broad, apically rounded, dark scales. Lower sternopleural bristles present. Cannot be distinguished from northern *melanesiensis*.

PUPA.—Pigmentation a very uniform, bright yellowish brown, abdominal intersegmental areas dark brown; trumpet bright deep yellow brown; integumentary abdominal sculpturing very uniform and distinct throughout. Trumpet index about 2.5; width at basal 0 1 about 0.5 of that at middle; pinna about 0.30. Hairs

5-IV–VI(2b); 2-II–VII(1); 1-II(irregularly dendritic); 1-IV–VI(4–6b). Paddle index about 1.70; midrib narrow; inner and outer margins without distinct spicules.

LARVA.—Pigmentation of head, thorax and abdomen light brownish yellow; thoracic and abdominal hairs yellowish brown. Head width about 0.97 of length, greatest cephalad of eye; hairs 14-C(about 10b), 15-C(about 8b, long). Thorax and abdomen with conspicuous stellate tufts of 30 or more slender yellowish branches; large single hairs not swollen or fringed near base. Thoracic hairs: 1-P(about 30b, shorter than 3-P), 2-P(1, shorter than 3-P), 3-P(5–7b, branches of unequal length), 5-P(1, only a little longer than longest 3-P branch), 7-T(2b, spinelike), 13-T(about 25b, not conspicuously larger than other stellate tufts). Abdominal hairs: 2-I–VII, 0, 14-II–VII large stellate tufts; 10-I–VII large stellate tufts comparable to others. Comb scales about 30 in number, sharply pointed and unfringed apically. Siphon index about 3.5; pecten teeth (8–10 on each side; broad at base); hair 1(5b), 1a(5 in number, mostly single; absent from basal third); 2a(about 18 in number, short, 2b or single). Anal segment: dorsal gill slightly less than 2.0 of saddle; ventral gill about 1.6 of saddle; hair 1(4b), 2(6b), 4(4b, about 3.0 of saddle).

Description

ADULTS.—Very similar to *melanesiensis*. I have not been able to find any characters to separate them from *melanesiensis*.

PUPA.—Abdomen: 3.36 mm. Trumpet: 0.53 mm. Paddle: 0.66 mm.

Cephalothorax: Lightly pigmented a uniform yellowish brown. Trumpet a bright deep yellow brown; length about 2.5 median width; width at basal 0.10 about 0.5 width at middle; anterior and posterior margins smoothly convex; inner wall distinctly separated to pinna; tracheoid on mesal surface at extreme base only; external reticulations very prominent; internal spicules long, strong in body of meatus, longer and thinner near pinna; pinna about 0.30. Hairs moderately to heavily pigmented a dark brown. Hairs: 1(2b from base, very long, with numerous slender fringes), 2(2b, about one half of 1), 3(5,6b, shorter than 2), 4(6b, shorter than 3), 5(5,6b, slightly longer than 3), 6(1), 7(2b, secondarily branched), 8(5b, slightly longer than 5), 9(2b, slightly shorter than 8), 10(6,7b, secondarily branched), 11(1, long), 12(3b, slightly shorter than 11).

Abdomen: Moderately and very uniformly pigmented a bright yellow brown, intersegmental areas darker; integumentary sculpturing very distinct and uniform throughout. Small hairs moderately pigmented, larger hair dark brown. Segment I: hair 1(about 30 primary branches, arising from elongate stem and enlarged base, with secondary branches and thin fringes), 2(1), 3(1), 4(4b in two primary branches), 5(8,10b, from a short stem), 6(not seen), 7(3b, from long stem), 10(1). Segment II: hair 0(1, small, very thin), 1(central stem, about 12 primary branches, some secondarily branched), 2(1,2b), 3(1), 4(4,5b), 5(6b), 6(not seen), 7(3f, ventral), 10(2b,3f, ventral), 11(1), 14(1, small). Segment III: hair 0(1, small, very thin), 1(8b, from enlarged basal stem), 2(1), 3(not seen), 4(4b, some secondary branching), 5(3b), 6(3b), 7(3f, ventral), 8(3, 4f), 10(5f), 11(1), 12(1–3f), 14(1, small, thin). Segment IV: hair 0(1, small, very thin), 1(5,6b), 2(1), 3(3,4b), 4(1,2b), 5(2b), 6(2,3b), 7(3f), 8(5–8f), 10(4f), 11(1), 12(2f), 14(1, small, thin). Segment V: hair 0(1, small, very thin), 1(5,6b), 2(1), 3(2b), 4(3,4b), 5(2b), 6(1), 7(2f), 8(7,8f), 10(3,4f), 11(1), 12(1), 14(1, small, thin). Segment VI: hair 0(1, small, very thin), 1(4,5b), 2(1), 3(1,2f), 4 (2–4b), 5(2b), 6(1), 7(3–8f), 8(7–9f), 10(2b, f), 11(1), 12(1), 14(1, small, thin). Segment VII: hair 0(1, small, very thin), 1(3,4b), 2(1), 3(1), 4(1), 5(4b, conspicuously fringed), 6(2, 3b, conspicuously fringed), 7(11,12b, conspicuously fringed), 8(6b, conspicuously fringed and secondarily branched; very large),

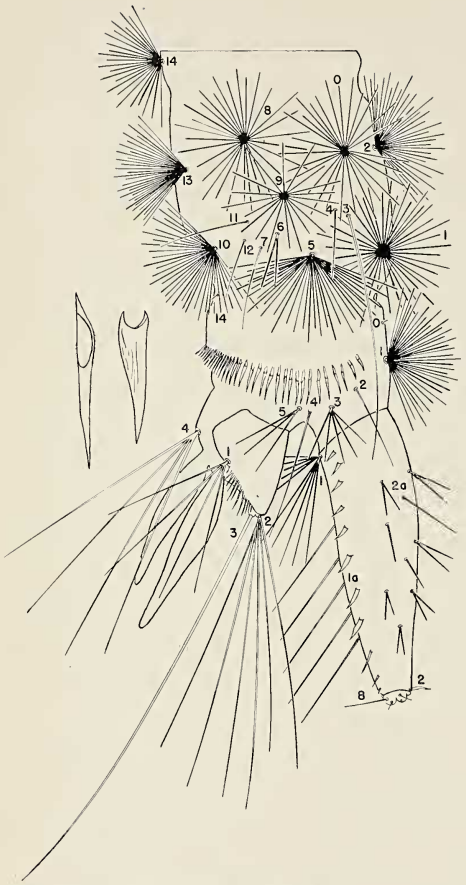

FIG. 2. *Tripteroides* (*M.*) *folicola* Belkin n. sp. Fourth instar larva; terminal abdominal segments, left lateral aspect. Espiritu Santo, New Hebrides, wild banana leaf axil (K-784).

10(1), 11(3,4b), 12(2b), 14(1, small, thin). Segment VIII: hair 0(1, small, very thin), 5(1, reaching about halfway down paddle), 7(13–17b, conspicuously fringed and sometimes secondarily branched), 14(1, small, very thin). Segment IX: dorsal lobe extending to 0.3 of paddle length; hair 1 apparently not developed. Paddle width about 0.58 of length; lightly pigmented; midrib narrow, strongly sclerotized and pigmented a yellow brown, evanescent at tip; margin without distinct spicules; hairs absent. Female genital lobe extending to 0.34 of paddle length.

LARVA (Holotype, K-784).—Head: 0.90 mm. Siphon: 0.78 mm. Anal saddle: 0.24 mm. Generally similar to *melanesiensis* except as noted.

Head: Width about 0.97 of length, greatest cephalad of eye; uniformly pigmented a light brownish yellow; no visible integumentary sculpturing; mental plate very dark brown, medium in size, with about 20 teeth; gula short, very broad caudally, maxillary sutures diverging caudally. Hairs of head capsule same color as integument or slightly darker. Chaetotaxy as in *melanesiensis* except as noted; hair 1(1, long, moderately curved, sharply pointed), 4(1, slender, mesad of 1), 5(2–4b, slender; more caudal than in *melanesiensis*), 6(2,3b, strongest dorsal hair; more mesal), 7(2b, slender), 8(3b, slender), 9(5,7b, slender), 10(1,2b, slender), 11(2,3b, very heavy dark spikes), 12(3,4b, slender), 13(1, halfway between 11 and 12 and mesad), 14(about 10b, a conspicuous stellate tuft with heavy branches), 15(about 8b, a conspicuous tuft with long branches). Antenna about 0.30 of head; width at middle about 0.18 of length; shaft hair (1-A) at about 0.60 from base; pigmentation and sculpturing as on head capsule. Antennal hairs pigmented as on head capsule except transparent apex of 5-A; 6-A long, slender, reaching to apex of transparent part of 5-A; all single except 1-A(2b).

Thorax: Integument, basal hair tubercles and hairs all light brownish yellow except larger hairs which are brownish; large single hairs without swelling near base and without distinct fringes. Chaetotaxy as in *melanesiensis* except as follows: larger stellate hairs with 30 to 45 slender branches arising in two or three distinct whorls from an expanded base, branches mostly sharply pointed and usually with minute fringes apically; metathoracic spine (7-T) dark brown, heavy, 2b, smaller branch reaching to about 0.70, often a third branch present; long single hairs shorter, 5-P only a little longer than longest branch of 3-P; 3-P(5,7b) with branches of unequal length, longest longer than the slender 2-P(1).

Abdomen: Pigmentation as on thorax; chaetotaxy generally as in *melanesiensis;* larger stellate

tufts as on thorax, generally with about 30 or more slender branches. Hairs 6-I–II(3,2b), 6-III–VI(2,3b, rarely 1), 7-I–II(2,3b). Terminal abdominal segments as in Figure 2.

Types

USNM No. 62389 (holotype, paratypes). Paratypes to be deposited in BMNH, CU and CSIRO (Canberra); also in coll. JNB.

HOLOTYPE: Larva (K-784), NEW HEBRIDES, *Espiritu Santo:* Bomber 3, Renee River area, October 17, 1943, in wild banana axils containing very small quantities of water (R. L. Ingram and J. Laffoon).

PARATYPES: (20L, 4P, 10M, 14F), same locality and habitat as holotype as follows: 9L, 2P, 1F (K-754), September 5, 1943 (K. L. Knight); 5M, 3F (K-771), September 14, 1943 (R. H. Daggy); 11L, 2P, 5M, 10F (K-784), October 17, 1943 (R. L. Ingram and J. Laffoon).

Discussion

T. folicola appears to be restricted to the island of Espiritu Santo in the New Hebrides and utilizes for breeding sites only water in leaf axils of living plants. I have seen specimens only from banana, *Alocasia* and sago palms but it is very likely that the specimens reported by Perry (1946: 13) as breeding in *Pandanus* are also this species.

The larvae from the different habitats are remarkably similar and, although there is some individual variation in chaetotaxy, there is no overlap whatever in diagnostic characters with *melanesiensis*. The fact that larvae from three different habitats are so similar strongly supports the interpretation that *folicola* is a distinct stabilized species rather than an ecophenotype of *melanesiensis*. It is also of interest to note that the parallel ecological type in New Caledonia, the "palm-bract" race of *melanesiensis*, has an entirely different larva. No other members of the *caledonica* complex have been reported breeding in leaf axils.

Distribution

NEW HEBRIDES, *Espiritu Santo:* 21L, 4P, 10M, 14F (K-754, 771, 784) Renee River area, September 5–October 17, 1943, from banana leaf axils (K. L. Knight, R. H. Daggy, R. L. Ingram and J. Laffoon); 1L, 5M, 6F (K-773) Renee River area, September 13, 1943, from sago palm axils (R. H. Daggy); 3L (L-E6) Namatasopa, September 3, 1952, from leaf axils of *Alocasia* sp. (Dr. & Mrs. M. L. Laird) [USNM, BMNH, CU, CSIR (Canberra), JNB].

3. ***T. (M.) melanesiensis*** Belkin, new species
Figs. 3, 4, 5

1927. *Rachionotomyia caledonica*. Buxton and Hopkins, Res. Polyn. and Melan. I-IV: 74–78 (*partim*).

1932. *Tripteroides* (*M.*) *caledonica*. Edwards, Genera Insectorum 194: 77 (*partim*).

1944. *Tripteroides* (*M.*) *caledonica*. Lee, Atlas Mosq. Larv. Australasian Reg. p. 22 (*partim*).

1944. *Tripteroides caledonica*. Knight, Bohart and Bohart. Keys Mosq. Australasian Reg. pp. 19, 67 (*partim*).

1946. *Tripteroides* (*M.*) *caledonica*. Lee, Linn. Soc. N.S.W., Proc. 70: 265 (*partim*).

1946. *Tripteroides* (*M.*) *caledonica*. Perry, Pan-Pacific Ent. 22: 13–14 (*partim*).

Diagnosis

ADULTS.—Abdominal tergites with apical light bands well developed, poorly developed or absent. Supraalar area without broad, apically rounded dark scales. Lower sternopleural bristles present. Cannot be distinguished from *folicola*.

Typical race: Abdominal tergites with apical light bands narrow and often interrupted mesally. Lateral light scaling of mesonotum not conspicuous.

Northern atypical races: Abdominal tergites with apical light bands narrow, often interrupted, sometimes completely absent. Lateral light scaling of mesonotum not conspicuous.

Southern atypical races and "palm-bract" race: Abdominal tergites always with broad apical light bands. Lateral light scaling of mesonotum very conspicuous.

PUPA.—Pigmentation moderate, a reddish brown dorsally on cephalothorax, proximal abdominal segments, and intersegmental abdominal areas, remainder lighter (except in palm-bract race); trumpet a bright reddish brown; integumentary sculpturing distinct on more heavily pigmented areas. Trumpet index about 2.8–3.0; width at basal 0.1 about 0.6 of that at middle; pinna about 0.15–0.20. Hairs 5-IV–VI(1); 2-II–VII(1–7b); 1-II(simply branched); 1-IV–VI(variable). Paddle index variable, length of paddle dependent on length of larval siphon; midrib narrow; inner and outer margins with spicules few and scattered.

Typical race: Hair 2-II–VII multiple.
Atypical races: Hair 2-II–VII single.

LARVA.—Pigmentation of head and unsclerotized integument of thorax and abdomen a light reddish brown, except in "palm-bract" race. Head width about 0.96 of length, greatest width cephalad of eye; hairs 14-C (usually 2b, thickened), 15-C(usually 8,9b, long). Thorax and abdomen with conspicuous stellate tufts always well developed, usually with not less than 5 and no more than 25 strong branches; large single hairs not swollen or fringed near base. Thoracic hairs: 1-P(variable, shorter than 3-P), 2-P(1, longer than 3-P), 3-P(variable), 5-P(1, about twice as long as 2-P), 13-T(variable, only slightly longer than other ventral stellate tufts). Abdominal hairs: 2-I–VII, 0,14-II–VII stellate, well developed; 10-I–VII stellate, well developed, comparable to other tufts. Comb scales, siphon, index, pecten teeth, siphonal and anal hairs and anal gills extremely variable but not as in *caledonica* or *folicola*.

Typical race: Hair 4-X about as long as saddle, usually with three or more branches; 1-X with five or more branches; dorsal anal gill about 1.15 of saddle. Siphon index 3.6 to 6.0; distance between 1-S and most proximal 1a-S distinctly greater than that between more distal 1a-S; usually 16 to 18 1a-S, mostly 3,4b; usually 13 or 14 2a-S, mostly 2b; pecten teeth 6 to 9, absent from basal fifth or more. Comb scales about 30, those at level of 5-VIII pointed apically and without distinct apical fringe; hair 1-VIII with about 16 branches; 5-VIII multiple. Large dorsal stellate tufts of abdomen with 14 to 25 strong branches.

Northern atypical races: Hair 4-X from 2.0 to 3.0 length of saddle, usually 2b; 1-X usually 2b; dorsal anal gill variable, often 2.0 of saddle. Siphon index variable, usually 2.5 to 3.5; distance between 1-S and most proximal 1a-S as in typical race; usually 8 to 11 1a-S, mostly 3,4b; usually 4 to 10 2a-S, mostly 3,2b; pecten teeth usually 4 or 5, absent from basal fifth. Comb scales usually 20 or less, those at level of 5-VIII often blunt or rounded apically and with distinct apical fringe; hair 1-VIII usually about 10b, 5-VIII usually 2b. Large dorsal stellate tufts of abdomen often less than 10b.

Southern atypical races: Hair 4-X from 2.0 to 3.0 length of saddle, usually 2b; 1-X usually 2b; dorsal anal gill variable, usually less than 2.0 of saddle. Siphon index usually about 3.0 to 3.5; distance between 1-S and most proximal 1a-S about equal to that between more distal 1a-S; about 15 1a-S, mostly 2b; usually 10 2a-S, mostly 2b; pecten teeth about 6, usually present in basal fifth. Comb scales about 30, those at level of 5-VIII blunt or rounded apically and with distinct apical fringe; hair 1-VIII about 16b; 5-VIII 3–6b. Large dorsal stellate tufts of abdomen usually 10–20b.

Palm-bract race (New Caledonia): Similar to southern atypical races except that dorsal anal gill is 3.0 or more saddle length, pecten teeth usually restricted to basal half of siphon and comb scales at level of 5-VIII with pointed apex. Pigmentation lighter than in other races.

Description

FEMALE (K-759a).—Wing: 3.35 mm. Abdomen: 2.15 mm. Proboscis: 3.00 mm. Front femur: 2.30 mm.

Head: Vertex with dark, iridescent bronzy, broad, appressed scales; narrow orbital line of smaller, narrower white scales, expanding into a patch on each side ventrally on postgena; occiput with a curved line of about 15 narrow, apically expanded, forked, erect brown scales on each side and a more caudal line of narrow, elongate, whitish recumbent scales projecting over broad vertical scales between the erect occipital scales; frontal pair of bristles brown, about 1.5 length of clypeus; dark orbitals 3:1, lower shorter. Clypeus about 0.06 of proboscis, brown and bare, cephalic portion and anteclypeus lighter and finely spiculate. Palpus about 0.1 of proboscis, base bare, remainder shaggy with dark scales and bristles. Proboscis very slender throughout and not markedly curved, uniformly and smoothly covered with moderately narrow dark iridescent scales; labella light apically, dark-scaled at base as rest of proboscis. Antenna about 0.6 of proboscis; torus very light brown, with a few short hairs and scales mesally and dorsally; flagellum darker; about 8 long bristles in a whorl; basal segment with numerous appressed scalelike hairs on mesal face; hairs more outstanding apically; apical three segments subequal to each other and to one of more basal segments.

Thorax: Scutal integument brown and with a faint indication of darker longitudinal lines; dense vestiture of small, bronzy, narrow, curved, appressed scales; laterally scales are lighter in color above the pleura; scales more slender, longer and less curved, and white in color on anterior promontory; area above paratergite with light and white scales longer and broader, only slightly curved and more outstanding; about six pairs of dorsocentrals merging into about six pairs of strong and several weaker prescutellars, dorsocentral row interrupted at level of scutal angle; acrostichals absent; 15 to 20 or more pairs of supraalars; anterior promontory with a pair of strong bristles in the middle and three bristles on each side; on each side one bristle near the border above *ppn* and another mesad and slightly caudad of scutal angle; all bristles dark. Scutellum brown; median lobe with four strong bristles and a pair of weak ones, densely covered with very dark, iridescent, broad, appressed scales; lateral lobe with four strong and a pair of weak bristles and with a few smaller dark, iridescent, broad, appressed scales. Postnotum dark brown, darker in the middle and laterally. Pleural integument dark brown, lighter under wing base, along membranous area and anterior part of *stp*, somewhat lighter under longitudinal scale streak; *ppn* with 12 to 15 small, broad, white, appressed scales near scutal border; a diagonal longitudinal streak of larger broad, white, appressed scales involving the middle of *an*,*p* lower part of *ppn*, lower subspiracular area, upper part of middle of *stp* and lower part of middle of mesepimeron; caudal border of *stp* from slightly above lower mesepimeral margin with vertical patch of similar scales; *pp* with a small patch of similar white scales, some more elongate ones projecting over membrane between fore coxa and sternopleuron; two or three white scales at base of upper mesepimeral bristles; *apn* with about four dark bristles in upper third, two strong dark ones in the middle and one dark and three or four light bristles in lower; *ppn* with one dark bristle slightly above ventral angle of spiracle; one dark and 2 light spiraculars; *pp* with 7 or 8 light bristles, 3 or more of which are long and somewhat darker; prealars 4 short, usually dark bristles and 2 to 4 light hairs; one weak, light upper sternopleural, slightly above level of scale streak; a group of 4 to 6 weak light lower sternopleurals at lower edge of vertical scale patch; upper mesepimerals a group of 10 to 12 light bristles; other bristles absent. Haltere light brown at base and stem, dark-scaled on knob.

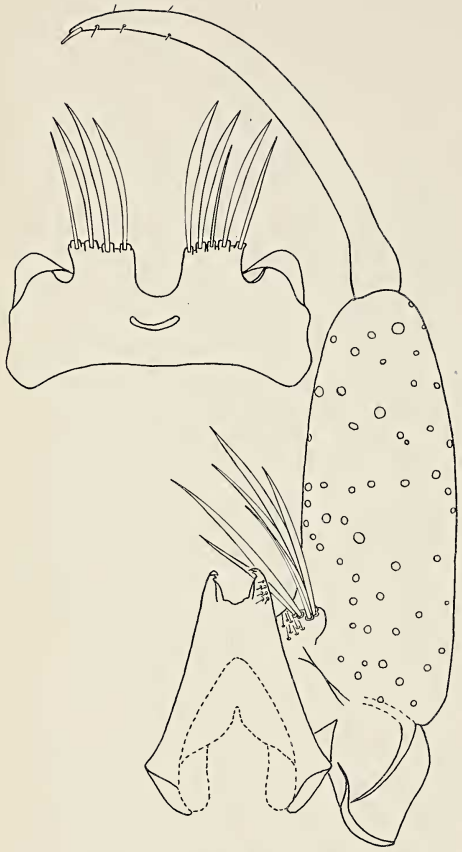

FIG. 3. *Tripteroides* (*M.*) *melanesiensis* Belkin n. sp., typical race. Male genitalia. Espiritu Santo, New Hebrides, tree hole (K-759).

Wing: Scales all dark. Outstanding vein scales all long and narrow, confined on dorsal surface to Rs, R_{2+3}, R_2, R_3, and to restricted portion of M basad and distad of crossveins, base of M_{1+2} and M_{3+4} and apex of 1A. Distance between crossveins about 3.0 of *m–cu;* vein R_3 about 2.6 of R_{2+3}; vein M_{3+4} about 1.33 of M distad of *m–cu;* base of cell R_2 slightly closer to wing base than that of cell M_2.

Legs: Coxae and trochanters with patches of white scales similar to those on pleura; femora dark-scaled above, light-scaled below; tibiae and tarsi entirely dark-scaled, lighter below. Leg I: femur 1; tibia 1.07; tarsus 0.64; 0.31, 0.21, 0.11, 0.10; claws normal, equal. Leg II: femur 0.89; tibia 0.96; tarsus 0.69, 0.36, 0.23, 0.10, 0.09; claws normal, equal. Leg III: femur 0.82; tibia 0.86; tarsus 1.00, 0.68, 0.50, 0.32, 0.14; claws small, equal.

Abdomen: Tergites 2 to 6 with narrow apical transverse light-scaled bands, broader laterally and often interrupted mesally; remainder of tergites with iridescent dark scales; sternites light-scaled.

MALE (K-759a).—Wing: 3.00 mm. Proboscis: 2.70 mm. Front femur: 2.00 mm.

Generally very similar to female. Abdominal apical light bands more extensive than in female and involving tergite 7; sternite 8 dark-scaled. Palpus about 0.8 of proboscis; apex with 3 moderately long bristles; segment 5 exclusive of terminal bristles 1; segment 4 about 1.18; segments 3 and 2 indistinctly separated and not articulated, about 1.45 and 1.25; segment 1 and palpifer about 0.47. Antenna about 0.66 of proboscis; longest flagellar whorls about 0.45 of flagellum; about 30 bristles in whorl; penultimate segment about 4.5 of preceding; apical about 0.85 of penultimate, with whorl of 8 shorter bristles. Leg I: femur 1; tibia 1.0; tarsus 0.65, 0.33, 0.23, 0.05, 0.08; claws unequal; shorter claw slender; heavier claw with small tooth slightly beyond middle. Leg II: femur 0.88; tibia 0.98; tarsus 0.78, 0.40, 0.26, 0.06, 0.08; claws as on fore leg but without tooth. Leg III: femur 0.85; tibia 0.88; tarsus 1.10, 0.70, 0.53, 0.30, 0.12; claws equal, minute.

MALE GENITALIA (K-759c).—As in Figure 3. Ninth tergite long laterally, rather uniformly and shallowly emarginate proximally on dorsal surface; apex deeply emarginate and with pair of prominent lobes; apical emargination slightly narrower than width of lateral lobe and about as deep as wide; lateral lobe slightly wider than long and with 4 or 5 long bristles, 3 of which are broadened and flattened before apex; a conspicuous apical ventrolateral sclerotization. Proctiger with heavy ventrolateral sclerotization ending in 1 to 3 dorsal teeth; a patch of microsetae laterally and subapically. Sidepiece with minute cuticular spicules and with long and short

bristles dorsally, laterally and mesally and with short bristles and scales laterally and ventrally. Basal lobe small but distinct and with 6 or 7 strong, heavy bristles and a patch of smaller bristles. Clasper with spine subterminal. Mesosome small, broad, heavily sclerotized, with a narrow dorsomedian basal emargination.

PUPA (K-759).—Abdomen: 3.42 mm. Trumpet: 0.50 mm. Paddle: 0.61 mm.

Cephalothorax: Moderately dark reddish brown middorsally, lighter laterally and ventrally. Trumpet a bright deep reddish brown; length about 2.9 median width; width at basal 0.1 about 0.63 width at middle; gradually widened from base to apex; inner wall distinctly separated to pinna; tracheoid on mesal surface at basal 0.1 only; external reticulations moderately distinct; internal spicules long throughout; pinna about 0.15 to 0.20. Ventral hairs moderately pigmented, dorsal darker. Hairs: 1(2b, about 0.9 mm.), 2(2b, about half of 1), 3(4,5b, about one-third of 1), 4(5–7b, about equal to 3), 5(4b, longer than 4), 6(4,5b, about half of 5), 7(2b, slightly more than half of 1), 8(1,2b, about equal to 7), 9(1, longer than 8), 10(3,4 primary branches, secondarily branched), 11(1), 12(2b, equal to or longer than 11).

Abdomen: Moderately dark reddish brown proximad, darker middorsally and in intersegmental areas, distad very lightly pigmented; integumentary sculpturing moderately distinct on more heavily pigmented portions, indistinct elsewhere; tergites II–IV without submedian spots (female character). Small hairs weakly or moderately pigmented, larger hairs darker. Chaetotaxy as figured by Knight and Chamberlain (1948, Fig. 6).

LARVA (K-759).—Head: 0.96 mm. Siphon: 1.24 mm. Anal saddle: 0.33 mm. Chaetotaxy as in Figure 4.

Head: Width about 0.96 of length; uniformly pigmented a light reddish brown; no sculpturing visible; mental plate small, with about 15 teeth. Hairs of head capsule moderately pigmented. Antenna about 0.3 of head, width at middle about 0.17 of length; mesal surface slightly and uniformly convex, lateral surface concave at base, convex beyond middle, producing swelling at about 0.6 from base; uniformly pigmented as head capsule; smooth, no sculpturing visible. Antennal hairs moderately pigmented, except apex of 5-A.

Thorax: Stellate hairs with branches of uneven lengths and usually ending in a blunt or minutely two-spined apex, shaft of branches weakly and sparsely feathered; larger simple hairs with short elongate spicules; metathoracic spine (7-T) densely covered with minute spicules; all hairs well pigmented, brown, darker than head capsule.

Abdomen: Hairs as on thorax. Comb scales well pigmented, sharply pointed apically and without distinct fringe at 400×. Siphon index about 6.0 (length to median width); moderately pigmented and with a dark ring at base; sculpturing apparently not developed; pecten teeth well pigmented. Anal saddle well pigmented, darker at base middorsally; sculpturing not distinct; median width about 0.8 of length; apicolateral spines well pigmented, sharply pointed.

Types

USNM No. 62390 (holotype, paratypes). Paratypes to be deposited in BMNH, CU, and CSIRO (Canberra); also in coll. JNB.

HOLOTYPE: Larva (K-759a), New Hebrides, *Espiritu Santo:* Segond Channel area, Sept. 21, 1943, tree hole (K. L. Knight, J. G. Franclemont, JNB).

PARATYPES (95L, 1P, 13M, 15F): All collected in or reared from tree holes on *Espiritu Santo*, as follows: 62L, 7M, 11F (K-759a), same data as holotype; 30L, 4F (K-794), Turtle Bay, Oct. 24, 1943 (R. L. Ingram); 3L, 1P, 1M, Big Bay, Aug., 1925 (P. A. Buxton).

Discussion

T. melanesiensis exhibits more striking variation in the larval stage than any other species of mosquito that I have seen. Each type of breeding place appears to have a peculiar form and every island has morphologically distinguishable populations. It would appear therefore that we are dealing with numerous ecophenotypes or possibly ecotypes or ecospecies as well as geographical races. The material at hand does not permit full analysis of this complex but indicates certain distinct trends.

The most clearly marked of all the forms of *melanesiensis* is a tree hole breeding form found in the northern and central New Hebrides. For this reason and because it has been described and figured by Buxton and Hopkins (1927: 74–78) I am selecting it as the *typical race*. It is characterized chiefly by the following characters: hair 4-X about as long as the saddle and usually with three or more branches, hair 1-X with three or more branches, siphon index 3.5 to 6. Outside of the type locality of Espiritu Santo (Fig. 4,5*d*) I have seen specimens from Aore Island (Fig. 5*c*) and Efate (Fig. 5*b*). In all probability the specimens collected by Buxton on Malekula and Pentecost also belong to this race. While there appears to be relatively little variation within populations of this race on the same island, there are striking differences between those from different islands, particularly in regard to the length and shape of the siphon. The typical race of *melanesiensis* does not appear to be entirely restricted to tree holes for specimens collected in foul water in a cold storage house on Espiritu Santo exhibit all the characters of this race.

All the remaining forms of *melanesiensis* have hair 4-X longer than the saddle and usually double or single, hair 1-X usually double, and the siphon shorter, index 3.5 or less. For the present all these forms are considered as atypical races of *melanesiensis* (Fig. 5*a*, *e–h*). With additional material it may be possible to characterize several races and possibly distinct species in this complex.

In the northern New Hebrides (Espiritu Santo, Aessi and Tutuba) atypical *melanesiensis* have been collected in coconut shells (Fig. 5*f*), bamboo (Fig. 5*a*), and cacao pods. In addition, at least one collection from tree holes on Espiritu Santo contains both typical and atypical *melanesiensis* without any intermediate forms. The atypical forms in this collection resemble closely the bamboo and coconut types and have a much shorter siphon as well as fewer and shorter branches in the stellate hairs than the typical race. Unfortunately it is not known whether or not the two types of larvae came from the same tree hole. The larvae from the other three types of habitats are generally similar but each has its peculiar morphological features. Since the number of collections is small, it is impossible to determine how constant these differences are. I have seen a number of larvae from Espiritu Santo which have the siphon longer than the other atypical *melanesiensis* but unfortunately no information is available as to their breeding place. These larvae have none of the diagnostic features of the typical race. Although *melanesiensis* has been reported from artificial containers on these islands (Perry, 1946: 14) none of the specimens I have examined are recorded as being collected in such habitats. It is possible that the above mentioned larvae without habitat data are from artificial containers. It should be noted that Buxton (Buxton and Hopkins, 1927: 76) collected only typical *melanesiensis* in the northern New Hebrides and only in tree holes. On the other hand during World War II atypical *melanesiensis* were collected more frequently than the typical. It is not beyond the realm of possibility that the atypical *melanesiensis* are not endemic to these islands but were introduced at that time.

In the central New Hebrides collections were seen only from the island of Efate. In addition to the typical *melanesiensis* from tree holes, larvae have been collected only in a

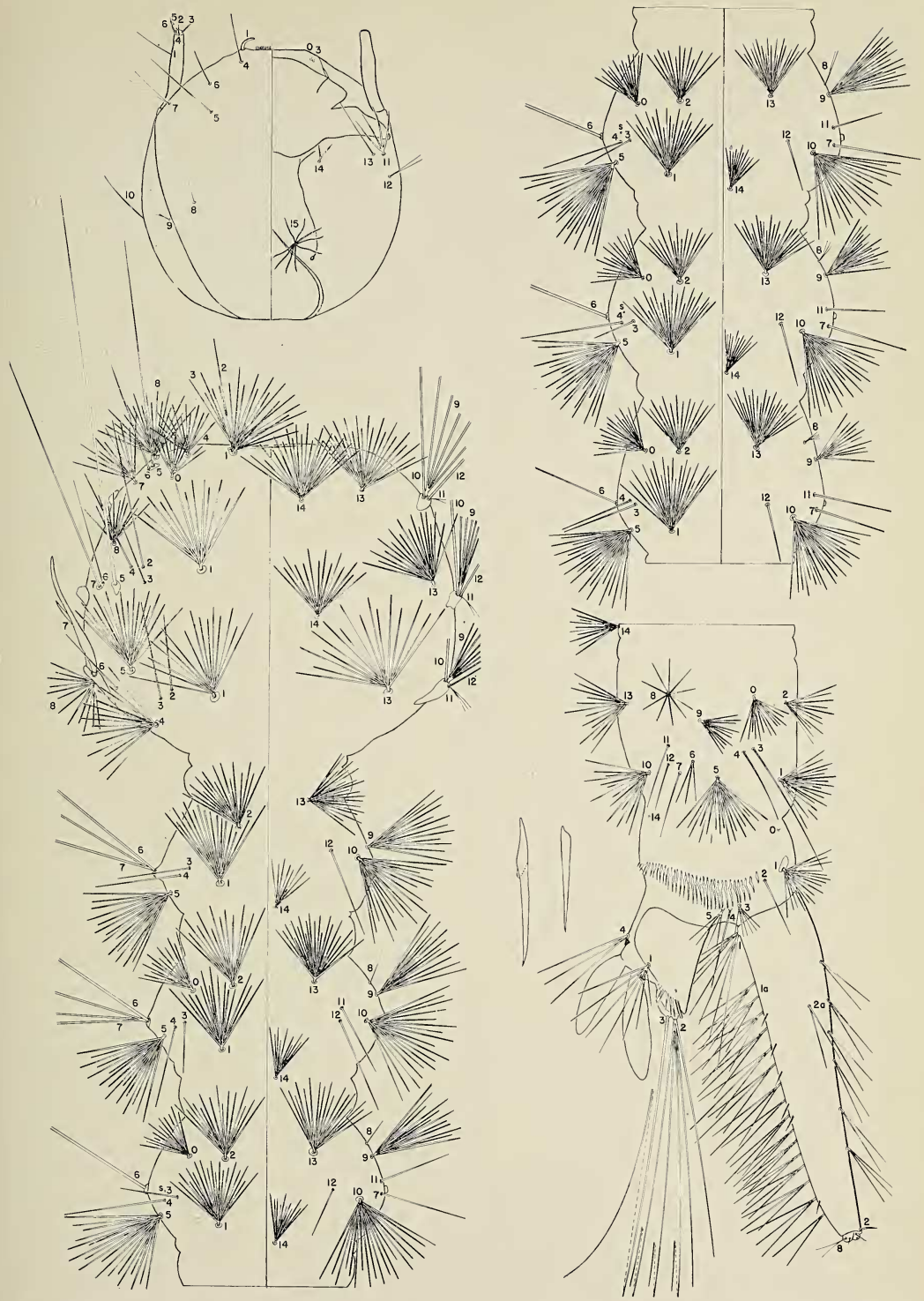

FIG. 4. *Tripteroides* (*M.*) *melanesiensis* Belkin n. sp., typical race. Fourth instar larva; head, thorax and abdominal segments I-VI, left dorsal, right ventral; terminal abdominal segments, left lateral aspect. Holotype, Espiritu Santo, New Hebrides, tree hole (K-759).

variety of artificial containers. At least two types are represented. One, from a paint pail, resembles Espiritu Santo larvae from bamboo and has a very short siphon, long hair 4-X and a few short comb scales. The other form, from an old tire, contains a variety of larval forms, some of which have a much shorter hair 4-X, less than 1.5 the length of the anal saddle, and the stellate tufts with longer and more numerous branches.

Collections are available from Aneituym and Futuna in the southern New Hebrides. The populations on Aneituym are quite distinct from those on Efate and have been found breeding in coconut shells, a tree hole, a tire, and a tin can with brackish water. All the larvae, except those in brackish water, have a long dorsal anal gill and all possess relatively short comb scales. The tree hole larvae have slightly longer, sharply pointed comb scales instead of blunt, and a greater number of branches in the stellate tufts. The populations on Futuna are quite distinct from those on Aneituym and have been found breeding in a rock hole in coral, a tree hole, a canoe and a small ground pool. All the larvae have the anal gills shorter, the comb scales more pointed, hair 4-X shorter and, except for those from the tree hole, a longer siphon. Larvae from the different habitats appear to be more similar than on the more northern islands and surprisingly the tree hole larvae have a shorter siphon than any of the others.

A single collection from a hole in a trunk of *Araucaria cookii* has been examined from E. Lifu in the Loyalties. These larvae resemble most closely those from New Caledonia and have a long siphon and about 30 long comb scales (Fig. 5*b*).

From New Caledonia I have seen five larval collections, three of them without habitat data, the others from tin cans and from flower bracts of palms. One of the larval collections without habitat data (La Foa) is probably from tree holes since the larvae have the characteristic pigmentation and development of stellate hairs associated with this habitat. In addition adults reared from larvae collected in bamboo stubble were examined. All the larvae fall within the atypical *melanesiensis* complex and exhibit much less variation in the length of the siphon and the number and character of the comb scales while retaining the usual variation in the branching of the stellate tufts. It is possible to segregate the New Caledonia populations, along with those from E. Lifu and Art Is., from the remaining atypical *melanesiensis* into a southern group on the basis of the characters indicated in the diagnosis. As will be noted below, the adults are also distinguishable. On the other hand there appears to be some intergradation of characters in the southern New Hebrides. The larvae from flower bracts of palms (Fig. 5*g*) appear to be distinct from the others especially in the extreme development of the dorsal anal gill and may represent a good species comparable to the *folicola* of Espiritu Santo. Since I have seen but a single collection of these larvae and the other material from New Caledonia is very scanty, additional material is necessary before a decision as to the status of this form can be made.

Finally, I have seen a single larval skin from a "rock pool into which assorted debris had been flushed by heavy rain" (Laird) on Art Island, Belep group (N. W. of New Caledonia). This larva resembles the New Caledonia and Loyalty atypical *melanesiensis*.

The adults of *melanesiensis* are quite variable in minor details of coloration. I have not been able to correlate any of these differences in the adults with the different larval ecological forms. Such correlation is particularly difficult because of the total lack of individual rearings. It is not even known whether or not some of the individual differences in the larvae are sexual. On the other hand geographical differences in adult coloration are quite evident. The forms in the New Hebrides are much darker than in New Caledonia and E. Lifu, as indicated in the diagnosis. The material from the southern New Hebrides is too scanty to determine whether or not this char-

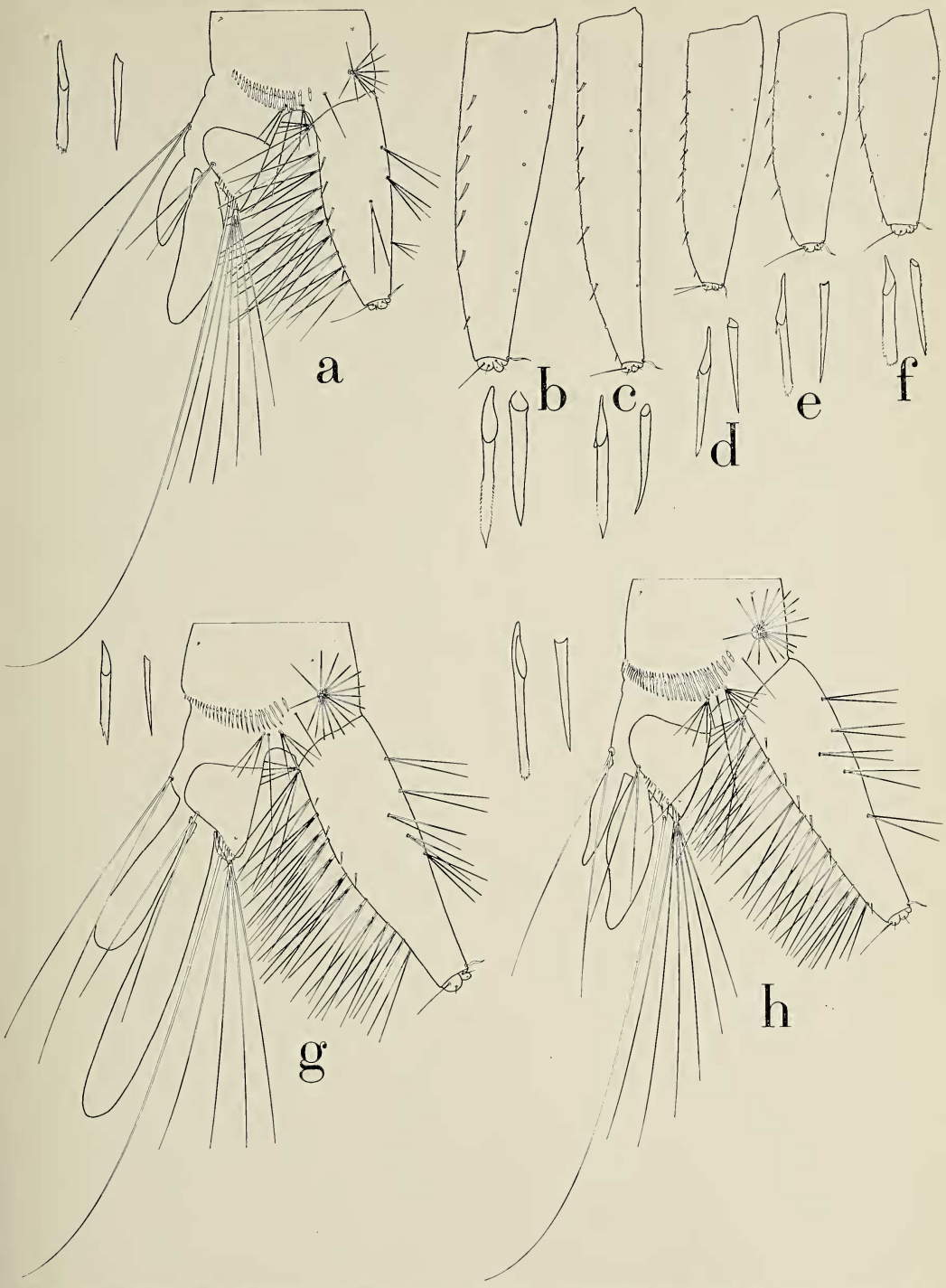

FIG. 5. *Tripteroides* (*M.*) *melanesiensis* Belkin n. sp., typical and atypical races. Fourth instar larvae; *a*, *g*, *h*, terminal abdominal segments, left lateral aspect; *b–f*, comb scale, pecten tooth and left lateral aspect of siphon. *a*, Espiritu Santo, New Hebrides, cut bamboo (K-788); *b*, Efate, New Hebrides, tree hole (K-1); *c*, Aore, New Hebrides, tree hole (K-941); *d*, Espiritu Santo, New Hebrides, tree hole (K-794); *e*, New Hebrides (W. J. Perry); *f*, Aessi, New Hebrides, coconut shell (K-795); *g*, Tinchialet, New Caledonia, "palm-bracts" (L. E. Cheesman); *h*, E. Lifu, Loyalties, Araucaria trunk (L. E. Cheesman).

acter exhibits a north-south cline but my impression is that there is a sharp break north of the Loyalties.

To summarize: *T. melanesiensis* has a wide variety of larval habitats over its entire geographical range. It is found generally in tree holes and artificial containers of many types as well as in dead plant material, such as coconut shells, cut bamboo and cacao pods. It can also utilize for breeding, at least temporarily, small ground pools and rock holes. Also it has been reported breeding in bamboo stubble. As has been noted above, the larvae reported from "palm-bracts" may represent a distinct species. *T. melanesiensis* apparently tolerates brackish water as well as water with high organic content such as in septic tanks. Distinct larval morphological features are associated with the type of larval habitat at least over part of the range. Thus tree-hole breeders generally have a longer siphon; shorter anal gills; darker pigmentation; a greater development of stellate tufts, accessory siphonal hairs and pecten teeth; and longer and more pointed comb scales. Breeders in coconut shells, bamboo and cacao pods represent the other extreme, while the larval forms from artificial containers are intermediate but are generally closer to the tree-hole breeders. On the other hand parallel ecological types in different portions of the range are usually distinct in other features, indicating in all probability distinct isolated genetic stocks on practically every island. There appears to be a sharp demarkation between the populations in the New Hebrides and those to the south, not only in larval but also in adult characters. In New Caledonia and adjacent islands the different larval ecological types are quite similar while in the New Hebrides, particularly in the northern islands, the ecological types are more numerous and are sharply differentiated from each other.

Attempts to segregate these various forms into ecological or geographical races are complicated by the fact that *melanesiensis* is a very plastic species for there is a great deal of individual variation within single collections as well as in different collections from the same habitat in at least some geographical areas. Differences in the development of stellate hairs, metathoracic spine, anal gills, comb scales, pecten teeth, length and shape of siphon, number and branching of accessory siphonal hairs are sometimes so striking that larvae from a single collection may appear to represent a very distinct species. Furthermore it is very likely that there is some contamination and mixing of local races through human agency. With the scanty material and the many geographical and ecological gaps it does not seem worthwhile to distinguish at the present more than the clearly marked *typical race* in the northern and central New Hebrides, the *northern atypical races* throughout the New Hebrides, the *southern atypical races* in New Caledonia, Loyalties and probably Belep group, and the *"palm-bract" race* in New Caledonia.

Distribution

New Hebrides, *Espiritu Santo:* 3L, 3M, 7F (K-755), 10 miles north of Bomber 3, Sept. 5, 1943 in cut bamboo shoots (K. L. Knight); 94L, 16M, 19F (K-759), Segond Channel area, Sept. 21, 1943, tree holes (K. L. Knight, J. G. Franclemont, JNB); 3M, 4F (K-774), stream north of Bomber 3, Sept. 14, 1943, cut bamboo shoots (K. L. Knight); 2L, 1M (K-781), Base 6 Hospital, Segond Channel, Oct. 10, 1943, cut bamboo shoots (K. L. Knight); 15L, 6M, 10F (K-785), north of Bomber 3, Oct. 17, 1943, cut bamboo (R. L. Ingram, J. Laffoon); 23L, 4M, 6F (K-788), Segond Channel area, Oct. 23, 1943, cut bamboo trunks (R. L. Ingram); 1F (K-790), Segond Channel area, Oct. 25, 1943, tree holes (J. Laffoon); 30L, 5M, 4F (K-794), Turtle Bay, Oct. 24, 1943, tree hole (R. L. Ingram); 1L (K-935), Sarakata Valley, July 29, 1943, foul water in cold storage house (K. L. Knight); 3L (K-946), Segond Channel area, Aug. 15, 1943, tree hole (R. L. Ingram); 3L, 1P, 1M,

Big Bay, Aug., 1925, tree holes (P. A. Buxton); 2L (W. J. Perry); 1M, 1F (No. 1), 1M, 3F (No. 24), South Pacific Serial 13 [USNM, BMNH, CU, JNB]; Hog Harbor and Big Bay, eleven larval collections in tree holes and cavities in buttress roots (Buxton and Hopkins, 1927). *Aessi:* 15L (K-795), 1943, coconut shell (K. L. Knight) [USNM]. *Aore:* 3L (K-941), Aug. 6, 1943, in open water-filled convolutions on cerba trees (K. L. Knight) [USNM]. *Tutuba:* 6L, 2P (L-4), Aug. 22, 1952, in pods of cacao (Dr. & Mrs. M. Laird) [USNM]. *Pentecost:* Lamalana, larvae in rot-hole (Buxton and Hopkins, 1927). *Malekula:* Bushman's Bay, larvae in deep cavity between main branches of a Poinciana tree; Tisman, several females in crab holes (Buxton and Hopkins, 1927). *Efate:* 2L, 6M, 5F (K-1), La Colle airport, Aug. 27, 1942, adults in pocket of water in root convolutions of banyan; 1L (K-4), water with much organic debris on top of gas barrel; 1L (K-67), Manouri Pt., near shore of Hearne Lake, Sept. 21, 1942, in convolution of banyan tree; 2L (K-136), Airport area, Oct. 27, 1942, reeking water in bottom of paint pail; 14L, 1P, 1M (K-310), Vila, seaplane base, Jan. 1, 1943, old tire; 1M (K-311), Vila, Jan. 15, 1943, septic tank; 1F (K-421), Tagabe and La Colle River areas, Feb. 1, 1943, adults in tents; 1M, 1F (K-425), Malafoa, Feb. 5, 1943, tin can with much dirt and fine debris; 1M, 1F (K-456), Vila, Feb. 8, 1943, fire barrel; 1M (K-551), March 2, 1943, top of oil drum; 2P (K-572), deserted native village, March 7, 1943, tin can with wood and leaves; 2M (K-750), Malapoa Point, April 26, 1943, road rut, water muddy and with a few leaves (K. L. Knight); 1M, 1F, 1943 (L. J. Dumbleton); 2L, March 13, 1943, mud puddles in camp [USNM]. *Aneityum:* 4L (B2), 6L (B4), Anelgauhat, Aug. 4 and 5, 1952, coconut shell pierced with small hole for drinking; 5L (F5), elev. 560 ft., Feb. 2, 1953, slit in tree trunk; 2L, 2P (F10), Anelgauhat, Feb. 18, 1953, truck tire; 3M (X6), Anelgauhat, Feb. 25, 1953, resting inside truck tire; 10L, 3M (X8), Anelgauhat, Feb. 26, 1953, coconut shell pierced with small hole for drinking; 7L (X9), Anelgauhat, Feb. 26, 1953, tin can near shore, brackish water (Dr. and Mrs. M. Laird) [USNM]. *Futuna:* Mission Bay, 2L, 2P, 1M, 2F (H5), Feb. 20, 1953, ground pool; 10L, 1P, (H6), Feb. 20, 1953, pot hole in block of coral on cliffs; 2L (V2), Feb. 21, 1953, tree hole; 5L (V6), Feb. 23, 1953, water in beached canoe (Dr. and Mrs. M. Laird) [USNM]. *No locality:* 20L (NH-6), June, 1944 (L. Jackowski, R. E. Kuntz); 2L (W. J. Perry); 1M, 2F, 1944 (McGhee) [USNM].

Loyalty Islands, *E. Lifu:* 14L, 2P, 10M, 12F, Cap des Pins, Nov. 18, 1949–Jan. 18, 1950, larvae in hole in trunk of *Araucaria cookii* (L. E. Cheesman) [BMNH].

Belep Group, *Art Is.:* 1L, 1P (R3), Nov. 30, 1952, rock pool into which assorted debris had been flushed by heavy rain, pupa died (Dr. and Mrs. M. Laird) [USNM].

New Caledonia, *Bouloupari:* 3M, 3F, July 31, 1944 (W. Crabb) [USNM]. *Bourail* (APO 25): 25L, 5P, 9M, 5F, July 18, 1944, larvae in tin cans; 10M, 11F, Aug. 17, 1944, larvae in bamboo stubble (A. R. Gaufin) [USNM]. *La Foa:* 11L (F-8), Jan. 20, 1945 (H. E. Milliron); 7M, 1F, April 8, 1945 (Pletsch & Remington) [USNM]. *Tinchialit:* 16L, 4P, 12M, 18F, Aug. 22–Sept. 10, 1949, larvae in flower bracts of palms, elev. 2020 ft. (L. E. Cheesman) [BMNH]. *No locality:* 1L (81–949), 24L (81–961), Feb. 6, 1945 (Gude) [USNM].

4. **T. (M.) rotumana** (Edwards, 1929)
Fig. 6

1929. *Rachionotomyia rotumana* Edwards, Bul. Ent. Res. 20: 337–338. *Types:* holotype male, paratypes 1M, 5F (larva and pupa), Rotuma Is., April, 1928 (W. D. Carew) [BMNH].

1932. *Tripteroides* (*M.*) *rotumana*. Edwards, Genera Insectorum 194: 77.

1943. *Tripteroides* (*M.*) *rotumana*. Paine, Fiji Dept. Agr. Bul. 22 (rev.): 9.

1944. *Tripteroides* (*M.*) *rotumana*. Lee, Atlas Mosq. Larv. Australasian Reg. p. 23.
1944. *Tripteroides rotumana*. Knight, Bohart and Bohart. Keys Mosq. Australasian Reg. pp. 19, 67.
1946. *Tripteroides* (*M.*) *rotumana*. Lee, Linn. Soc. N. S. W., Proc. 70: 267.

Diagnosis

ADULTS.—Abdominal tergites III–VII with basal lateral creamy spots, larger and just visible dorsally on distal segments; lower sternopleural bristles absent (Edwards, 1929).

PUPA.—Pigmentation light except for dark brown cephalothorax, base of abdomen and intersegmental areas; trumpet uniformly dark; integumentary abdominal sculpturing distinct only on darker areas. Trumpet nearly parallel sided, index 4 or more; width at basal 0.1 nearly equal to that at middle; pinna about 0.20. Hairs 5-IV–VI(1); 2-II–VII(1); 1-II(irregularly dendritic); 1-IV–VI(3–5b). Paddle index about 1.66; midrib narrow; inner and outer margins with one distinct dorsal row of long spicules.

LARVA.—Head capsule bright yellowish brown; integument of thorax and abdomen light yellowish brown. Head width about 1.04 of length, greatest caudad of eye; hairs 14-C(1, thin), 15-C(8–13b, thin, secondarily branched). Thorax and abdomen with conspicuous, thin, moderately or poorly developed stellate hairs. Thoracic hairs: 1-P(5–9b, shorter than 3-P); 2-P(1, longer than 3-P), 3-P(2,3b), 5-P(1, less than twice as long as longest 3-P branch), 7-T(2b, hairlike not spinelike), 9-T(11–13b), 13-T(10, 11b; large and with uneven branches). Abdominal hairs: 0-II–VII, 2-I–VIII, 14-II–VI(stellate tufts); 14-VII(1, small or minute); 8-VII(3b; small, not stellate); 1,5,9,10,13-I–VII(stellate; usually 5–7b). Comb scales about 20; blunt and distinctly fringed apically; minutely fringed laterally. Siphon index about 2.3; pecten teeth (about 7 on each side; narrow, sharply pointed and often with minute spicules laterally; about as long as or longer than longest comb scale); hair 1(4b), 1a(usually 10, mostly 3b), 2a(usually 5, mostly 3b). Anal segment: dorsal gill about 1.2 of saddle; ventral gill about 0.8 of saddle; hair 1(1, heavy), 2(8b), 4(4b, about 3.1 of saddle).

Description

ADULTS.—Apparently very similar to *melanesiensis* except for diagnostic characters. I have not seen any specimens.

PUPA.—Abdomen: about 2.6 mm. Trumpet: 0.32 mm. Paddle: 0.43 mm.

Cephalothorax: Moderately blackish brown, darker on wing case. Trumpet uniformly dark blackish brown; length about 4.2 median width; basal 0.12 gradually narrowed to extreme base which is about 0.3 of median width; beyond basal 0.12 parallel sided except for slight constriction at about 0.5; inner wall

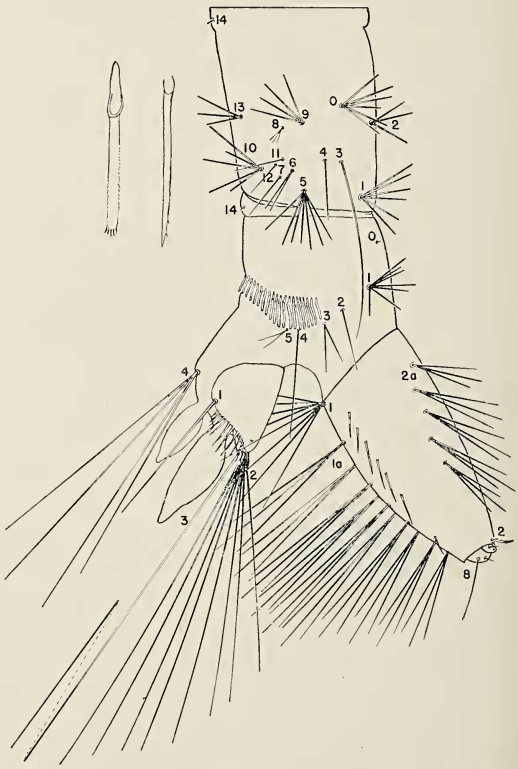

FIG. 6. *Tripteroides* (*M.*) *rotumana* (Edwards, 1929). Fourth instar larva; terminal abdominal segments, left lateral aspect; considerably distorted through compression. Rotuma (W. D. Carew).

distinctly separated to apex; tracheoid on mesal surface of basal stalk; reticulate indistinct, without conspicuous spicules; pinna about 0.20. Hairs moderately to heavily pigmented. Hairs: 1(2b, very long), 2(2b, one branch secondarily forked; about 0.26 of 1), 3(2b, each secondarily 2f), 4(3b), 5(5b), 6(1), 7(2b), 8(1,2b, long), 9(1), 10(1), 11(1), 12(1, 2b).

Abdomen: Lightly pigmented except for middorsally proximad and on intersegmental areas; integumentary sculpturing distinct on darker segmental areas only. All hairs moderately to darkly pigmented. Segment 1: hair 1(about 22 primary branches arising from short expanded base, secondarily branched or fringed), 2(1), 3(1), 4(1,thin),5(2–4b),6(2b), 7(1), 10(2b). Segment 2: 0(1, minute), 1(9, 11bd, with long central stem irregularly dendritic), 2(1, thin, laterad of 1), 3(1, long), 4(4b), 5(2b), 6(1, shorter than 3), 7(1), 10(3b, ventral), 12(1), 14(not seen.) Segment 3: hair 0(1, minute), 1(5,6b), 2(1), 3(1), 4(2,3b), 5(3b), 6(3b),7(1), 8(2b), 10(3b),11(3b),12(1), 14(1). Segment 4: hair 0(1, minute), 1(4,5b), 2(1), 3(3b), 4(1), 5(1), 6(2b), 7(1), 8(3b), 10(2b), 11(4b), 12(1), 14(1). Segment 5: hair 0(1, minute), 1(3–5b), 2(1), 3(2–3f), 4(2b), 5(1), 6(3b), 7(1), 8(6b,f), 10(3b), 11(1), 12 (1), 14(1). Segment 6: hair 0(1, minute), 1(4b), 2(1), 3(2b), 4(3b), 5(1), 6(2b), 7(1), 8(5b,f), 10(2b), 11(2b), 12(1), 14(1). Segment 7: hair 0(1, minute), 1(not seen), 2(1), 3(1), 4(1), 5(4b,f), 6(2b), 7(11b), 8(2b), 10(2f), 11(1, 2f), 12(1), 14(1). Segment 8: hair 0(1,, 5(1, reaching slightly beyond middle of paddle), 7(20–24b), 14(1). Segment 9: dorsal lobe extending to 0.33 of paddle, hair 1 apparently not developed. Paddle width about 0.6 of length; lightly pigmented; midrib narrow and strongly sclerotized, evanescent apically; external margin strongly sclerotized in basal half; apical half of external and internal margins with distinct long spicules, longer distad; hairs absent. Male genital lobe extending to about 0.8 of paddle.

LARVA.—Head: 0.85 mm. Siphon: 0.60 mm. Anal saddle: 0.26 mm.

Head: Width about 1.04 of length, widest cephalad of eye; pigmentation a uniform bright yellowish brown; sculpturing indistinct; mental plate dark brown, large, with about 17 teeth, median teeth not strongly differentiated; gula long, broadened caudally, maxillary sutures diverging caudally. Hairs of head capsule same color as integument or slightly darker. Chaetotaxy as in *melanesiensis* except as noted; hairs 4, 5 and 6 more mesal, 8(2f), 11(a single spike or 2b), 12,13(1), 14(1, thin), 15(8–13b, long thin branches, some secondarily branched). Antenna about 0.28–0.30 of head; width at middle about 0.15 of length; shaft hair at about 0.6; pigmentation and integumentary sculpturing as on head capsule. Antennal hairs same color as integument; hair 1(2b), all others single; 6-A long, slender, reaching beyond base of transparent part of 5-A.

Thorax: Integument light yellow brown; hairs darker than on head capsule; tubercles light yellow brown; stellate hairs moderately well to poorly developed, branches of equal or unequal lengths, usually blunt and ending in two minute points, shafts usually smooth; larger single hairs smooth; hair arrangement generally as in *melanesiensis* except as noted. Prothorax: 0(5b), 1(5–9b, long but shorter than 3-P), 2(1, longer than 3-P), 3(2,3b), 4(5b), 5, 6(1), 7(5–7b), 8(5, 6b), 9(4–6b), 10(1), 11(1), 12(1), 13(9–11b), 14(5–7b). Mesothorax: 1(4–6b), 2–7(1), 8(3–5b), 9 (10b), 10(1), 11(1), 12(1), 13(4b), 14(4b). Metathorax: 1(4b), 2, 3(1), 4(3b), 5(5b), 6(1), 7(2b; principal branch straight, hardly swollen, not spinelike; smaller branch from 0.6 to almost as long as principal), 8(3b), 9(11–13b), 10(1), 11(1), 12(1), 13(10,11b; very strong, branches unequal).

Abdomen: Pigmentation and stellate hairs as on thorax; chaetotaxy generally as in *melanesiensis;* stellate tufts generally with less than 10 branches, usually 5–7b. Hair 14-II–VI usually stellate, 2–5b, occasionally a single large spike; 14-VII minute or small, single.

Hair 8-VII not stellate, small, usually 3b. Hair 6-I–II(4,3b, occasionally 2b), 6-III–VI (2b,1), 7-I–II(3,2b). Terminal abdominal segments as in Figure 6.

Discussion

Apparently this species has been collected only once. I have seen three whole larvae and two pupal skins through the courtesy of Dr. Mattingly. Much more material is needed before the range of variation in the chaetotaxy of this species can be determined but there is little doubt that *rotumana* is a member of the *caledonica* complex. It is interesting to note that *rotumana* is the most isolated member of this complex geographically and that it is the only one that has developed striking differential adult characters. On the other hand, in the immature stages it has not departed markedly from the general pattern in the complex, certainly not as much as *caledonica*. There is no data as to the larval habitat. The short siphon and the poor development of the stellate hairs in the larvae of *rotumana* that I have examined suggest that these larvae were not tree hole breeders but this is contradicted by the small size of the anal gills and the branching of hairs 1 and 2 on the anal segment. The three larvae exhibit considerable variation in the development of the stellate tufts. Since these larvae were probably collected in a single breeding place, this variation suggests that *rotumana* may also show environmental modifications in different habitats.

Distribution

ROTUMA ISLAND. Larvae collected Apr., 1928 (Dr. W. D. Carew), reared in Suva, Fiji, by R. W. Paine [BMNH].

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